RETHINKING C-17A TRAINING REQUIREMENTS: AIR REFUELING

GRADUATE RESEARCH PAPER

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Abstract

In 2013, the Air Force's budget for flying hours was dramatically reduced as a result of sequestration. In the wake of this reduction, senior leaders began searching for efficient means to save money and still perform the Air Force's core functions. Should sequestration take effect again, Air Mobility Command (AMC) will have to face fiscal realities that will require smart solutions to difficult problems regarding its capability to field a mission capable force. AMC's C-17A community currently trains its Aircraft Commanders (ACs), Instructor Pilots (IPs), and Evaluator Pilots (EPs) in a myriad of mission sets that it rarely calls upon them to execute. Aerial Refueling (AR) represents one such mission set. While continually tasked to remain current with AR, this author only experienced two "real world" missions that required AR in eight years of experience. The question then becomes, what cost is AMC willing to pay in order to maintain this C-17A AR capability to support Combatant Commander (COCOM) needs? This study seeks to examine the implications of reducing the C-17A community's AR training requirements by limiting AR qualifications to only the IPs and EPs. This study analyzes the current C-17A flying program, the costs of maintaining the current AR training requirements, and conducts a cost benefit analysis of reducing those requirements for future operations. Substantial cost savings are possible.

Acknowledgments

I would like to express my sincere appreciation to my faculty advisor, Dr. Alan Johnson. Your support throughout the production of this Graduate Research Paper provided it with the required focus and impact. I would also like to thank my sponsor, Col Andrew Hird, 62 Operations Group Commander. Your provocative inputs, subject matter knowledge, and desire to pursue meaningful change provided motivation for this research.

Kyle M. Clinton

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RETHINKING C-17 TRAINING REQUIREMENTS: AIR REFUELING

I. Introduction and Problem Statement

Introduction

The C-17A Globemaster III is the workhorse of AMC's intra- and inter-theater airlift capabilities. It accomplishes an assortment of missions including Airland, Airdrop, Special Operations Low Level II (SOLL II), Special Assignment Airlift Missions (SAAMs), Antarctic resupply, Prime Nuclear Airlift (PNAF), overseas contingency operations (OCO), humanitarian relief, and aeromedical evacuation (AE). Many of these missions require special training and qualifications to execute while others do not. Currently Air Mobility Command (AMC) requires that all of its aircraft commanders (ACs) be qualified in air refueling (AR). Unfortunately, only a few of them will conduct AR during real world missions in their careers. Maintaining a pool of aircraft commanders, current in air refueling, could cost taxpayers millions of dollars supporting a capability that may never be used.

In order to become qualified in AR, pilots must attend the C-17A formal training course known as Pilot Checkout (PCO). Each C-17A unit has their own processes for determining which pilots get picked for AC upgrade and what training they will receive before attending PCO. For the sake of this research, the processes of the 62d Operations Group (OG) at Joint Base Lewis-McChord (JBLM), WA serves as a basis for this identification and preparation process.

To attend PCO, squadron leadership must first identify an individual as a pilot capable of taking on more responsibility in the aircraft. Air Force Instruction (AFI) 11-

2C-17, Volume 1 establishes the Mobility Pilot Development Program (MPD) which is the development program that culminates in a pilot receiving an Aircraft Commander Certification. The MPD flows from Initial Qualification through continuation training through Aircraft Commander Certification. It is divided into three phases, MPD Phase I, Phase II, and Phase III. MPD Phase I consists of completing the MPD Phase I guide, which focuses on core aircraft abilities including communication, checklist discipline, systems knowledge, and basic mission planning (AFI11-2C-17V1, 2012). This phase concludes 180 days after initial Mission Ready qualification.

MPD Phase II consists of the developmental flight time between being a knowledgeable copilot and an AC candidate. During this phase, pilots advance in knowledge and are encouraged to practice actual mission management skills and decision making under the guidance of an AC or IP. Based upon performance, experience, and requisite flight hours, Phase II MPD pilots are identified for upgrade by squadron leadership via the Squadron Training Review Panel (STRP) (AFI11-2C-17V1, 2012). The requisite numbers of hours to upgrade to AC are between 400 and 1,000 hours (AFI11-2C-17v1). However, the 62d OG uses 700 hours as a PCO prerequisite (Airland PDG, 2014). Additional prerequisites required by JBLM leadership include a training simulator flight with an Instructor Pilot (IP), completion of MPD Workbook II, Global Reach Aircraft Commander's Course (GRACC) tour, Line Training Mission (LTM) 1, at least one AF Form 8 Evaluation since becoming mission ready, squadron Operations Officer (DO) recommendation to attend PCO, a Tactical Simulator Flight with an IP, a complete PCO Prep Workbook, and a Night Local Flight (Airland PDG, 2014). Realizing the demands this places on an AC candidate, the 62d OG Commander

mandates that crewmembers will be kept at home station for the maximum extent possible 45 days prior to departing for a formal upgrade course in order to complete course prerequisite training requirements in AFI 11-2C-17V1 and the 62d OG Mobility Pilot Development Guide (MPDG) (62 OGI 11-2C-17V1, 2013). Once all of the aforementioned tasks are completed, the pilot is deemed ready to attend PCO.

PCO is the formal training course for all C-17 aircraft commanders. Conducted at Altus Air Force Base (AFB), OK, PCO spans seventeen training days and consists of two simulator sorties, six aircraft sorties, and nearly eight hours of academic instruction via computer based trainers (CBTs). The total number of dedicated training hours for this course is 98.25 hours (PCO Syllabus, 2013).

The first training day of PCO consists of CBT completion. The subjects covered during this training include Course Introduction, Category II Instrument Landing System (ILS) Procedures, Low-Level Flight, Instructional Procedures, Leadership Skills, Air Refueling Procedures, Rendezvous Procedures, Air Refueling Emergency Procedures, Training Management System (TMS) training and Fuel Planning/Double AR training (PCO Syllabus, 2013). The second and third training days consist of two Weapons System Trainer (WST) simulator sorties, titled Air Refueling 1 and Air Refueling 2. According to the course syllabus, WST training is provided for air refueling, low level, assault landing, and time control procedures. During these simulator flights, students take turns performing rendezvous, contact, and post AR procedures as well as day and night assault landing procedures.

From the WST, the student progresses to the physical flying portion of the program. This flying phase of training is provided for practice of normal procedures

during day and night refueling, assault landing, NVG operations, and low level proficiency (PCO Syllabus, 2013). The first two flights are dedicated to day AR operations. These two flights are titled FLT1: Day Air Refueling Training and FLT 2: Air Refueling Training (PCO Syllabus, 2013). Each of these sorties is preceded by a dedicated day (8 hours) of mission planning. Flights 3, 4, and 5 are "night block sorties". These sorties are dedicated to ensuring each student is proficient in night AR and night vision goggle (NVG) operations. The final sortie (6) is the United States Air Force (USAF) Evaluation for PCO. Upon completion of this evaluation, the pilot returns to their home unit to continue their progression to becoming a certified aircraft commander.

Upon return to the 62d OG, AC candidates continue their progression through MPD Phase III. The focus of this phase is to gain experience acting as an aircraft commander through crew/mission management. The goal of this phase is to successfully complete an Operational Mission Evaluation and gain AC certification (Airland PDG, 2014). To accomplish this, AC candidates must successfully accomplish two more LTMs prior to a recommendation ride and ultimately their Operational Mission Evaluation (OME). LTM 1 and LTM 2 require the AC candidate to act as the AC during mission execution as well as pre-mission planning, setup, and post mission requirements (Airland PDG, 2014). They are to conduct all mission briefings and debriefings, complete required paperwork, and coordinate with en route support and command and control agencies. The mission requirements for these LTMs include an Oceanic Sortie, 1 "Remain overnight" (RON), and at least 3 mission legs (Airland PDG, 2014). And, while it is desired that an IP be onboard the aircraft for these missions, it is not a requirement.

The next flight in MPD Phase III is the recommendation ride. Like LTM 1, 2, and 3, this mission has many of the same requirements. However, it must have an IP onboard to determine whether or not the AC candidate is ready to progress to their OME. And while AR is desired on the mission, it is not required. The final flight in the AC candidate's progression towards certification is their OME. All pilots must complete this one-time OME demonstrating their ability to operate in command of an aircraft performing the unit's primary mission after PCO but prior to their certification as an Aircraft Commander by their Squadron Commander. The minimum profile for this sortie consists of two mission legs (one over a category 1 route), takeoff, arrival and landing, an off-station RON, and tactical maneuvers if practical (AFI11-2C-17V2_62AW SUP, 2005). However, if the OME takes place in a deployed environment, the requirements change. The 62d OG has determined that during a deployment the ocean crossing (i.e. category 1 route) cannot be accomplished. Therefore, the OME profile includes, three crew rests, three missions, takeoff, arrival, landing, and tactical maneuvers (FCBs, 2013). Therefore, the Evaluator is allowed to determine AC candidate competence of oceanic procedures through verbal evaluation. Following redeployment to McChord, Instructor Pilots complete an oceanic airspace "over the shoulder" ride on these specific Aircraft Commanders on their first overseas mission in command (FCBs, 2013).

After completion of the OME, the AC candidate must accomplish a series of Commander's Review Boards at the Squadron, Group, and Wing Level. While the Squadron Commander certifies the AC candidate to operate in their new position as an AC, the Group and Wing Commanders must confirm this certification. That is to say, although the AC candidate is now certified by the Squadron Commander, they are not

allowed to fly in this capacity prior to OG/CC review (AFI11-202V2, 62 AW Supplement, 2010). Furthermore, if the pilot is upgrading to AC for the first time, the Wing Commander must conduct their review before the new AC is allowed to fly in this capacity as well.

Problem Statement

In the current model, C-17A pilots train for a minimum of 700 flight hours to gain entry into the Aircraft Commander developmental pipeline. Once established in the program, hundreds of thousands of dollars are spent making them proficient in aerial refueling. However, once these pilots become certified ACs, the likelihood of conducting AR during a real-world mission is minimal. Based on the current financial constraints it faces, the USAF, and AMC specifically, should reconsider how it trains its C-17 crew force to meet the desires of the Combatant Commanders (COCOMs).

Research Question

The research question thus follows:

How much can AMC save by addressing the way it trains and maintains its C-17A crew force for air refueling?

The following questions are addressed:

1. What are the costs associated with putting a pilot through PCO?
2. What percentage of a C-17A squadron is made up of Aircraft Commanders?
3. Historically, how many C-17A operational missions require AR per year?
4. What effect have Extended Range (ER) tanks for the C-17A had on AR missions?

5. How many hours do KC-135Rs spend flying AR against a C-17A?

After this data is captured and analyzed, the following questions are answered:

6. What are the lifecycle costs of training a C-17 pilot in air refueling?
7. What is the cost savings associated with removing PCO from a C-17A pilots upgrade training?
8. What is the cost savings associated with reducing C-17A training requirements as it pertains to KC-135R operations?
9. What is the operational risk associated with an insufficient number of air refueling qualified pilots?

Research Objective and Focus

The current method for developing C-17A aircraft commanders does not concern itself with the proper balance of capability versus utility. COCOMs do not maintain a constant demand for AR that the C-17A capacity would lead planners to believe. Therefore, one focus of this research paper will be to determine the lifecycle costs of developing and maintaining a current and qualified C-17A aircraft commander. The Literature Review will provide an historical analysis of demand for AR by C-17A operations from 2001 until 2014. This research will be used to determine a demand trend for AR based on the full spectrum of combat operations, from mobilization through retrograde. Ultimately, though this analysis, this research project will provide AMC leadership with an analysis tool that will estimate the costs of maintaining a C-17A crew force, current in air refueling, that meets COCOM requirements.

Methodology

This research used C-17A Flying Hour Program (FHP) data. It assessed the number of C-17A aircraft commanders AMC maintains. Next it calculated the required number of events it takes for an AC to maintain their AR currency. Each event has a number of flight hours associated with its accomplishment. Therefore, by multiplying these three numbers by the cost per hour to operate the C-17A, this research determined the total cost of maintaining a C-17A crew force current in AR. This cost is then compared with the recommended model to determine cost savings of reducing the number of AR capable C-17A aircraft commanders.

Additionally, this research examined AMC's KC-135R FHP to identify potential areas to save money. Projected versus actual flight hours from 2001-2014 were assessed. This identified room where the KC-135R could decrease its number of flight hours supporting C-17A aircraft and in-turn save additional money.

Finally, the lifecycle cost of developing a C-17A aircraft commander was addressed. The associated costs of this lifecycle assessment included, lodging, per diem, simulator costs, and C-17A operating costs. All of these costs were then combined to determine both the cost of current operations versus the savings that can be gained by removing this lifecycle cost.

Assumptions/Limitations

This research maintains a number of simplifying assumptions. First, in order for a C-17A to accomplish an air refueling event, the FHP provides it with a designated number of hours. That number of hours is assumed to be the same for the corresponding

KC-135R that enables that training. Next, like the C-17A FHP, this research assumes a 10% re-fly rate because not every mission will get airborne to accomplish its training. Third, this research assumes that the cost per flying hour for both the C-17A and the KC-135R remains constant. Finally, although human error exists in the input of data into Global Defense Support System II (GDSS II), this research assumes that the mission data pulled from data capturing systems like GDSSII is true and accurate.

Implications

This research could highlight unnecessary training taking place by the C-17 crew force. By removing these training and TDY requirements, AMC and the Air Force stand to save hundreds of millions of dollars a year. Additionally, aircrew members will become more specialized and therefore proficient in their primary responsibility. Consequently, the C-17s will be flown safer and more precise than in previous years.

II. Literature Review

Chapter Overview

This chapter looks at the current energy environment that the DoD is navigating. It assesses the current position of the United States Air Force (USAF) as it pertains to energy conservation and proper spending of the "taxpayer dollar". It also reviews the concepts of aerial delivery and the effects of aerial refueling can have on airlift operations. Next it discusses the Air Force's Single Flying Hour Program Model and compares it specifically to the C-17A model. Finally this chapter discusses the different funds that the C-17A and KC-135R aircraft use to fund their flying hours programs.

The Current Energy Environment

The United States' military requires a vast amount of energy in order to accomplish its mission. The DoD is the largest consumer of energy in the world (Hoy, 2008). The Air Force alone accounts for 48 percent of the total DoD energy consumption and slightly more than 50 percent of the total DoD energy costs, with a vast majority of this for aviation fuel (MAF Strategy, 2013). In Fiscal Year 2009 (FY09), the Air Force spent $5.6 billion for 2.61 billion gallons of fuel. In FY11, the service bought almost the same amount of fuel but paid $8.8 billion for it. That's a $3.2 billion increase, or 57%, in energy expenses over just two years (Starosta, 2012). In fiscal year 2007, DoD reported that the department consumed almost 4.8 billion gallons of mobility fuel and spent $9.5 billion. Although fuel costs represent less than 3 percent of the total DoD budget, they have a significant impact on the department's operating costs. The DoD has estimated that for every $10 increase in the price of a barrel of oil, its operating costs increase by

approximately $1.3 billion (GAO, 2008). Due to the high costs associated with the consumption of these resources, in conjunction with the tightening fiscal constraints placed on the DoD in recent years, the Air force and Air Mobility Command have placed a greater emphasis on fuel efficiency.

The Air Force's Fiscal Responsibility

Today's Air Force is the smallest is has been since its inception. Because of the constraints of today's fiscal environment it has had to reduce its numbers to just over 327,600 Airmen (James, 2014). In order to accomplish its core competencies, despite this draw down, Air Force leadership has provided a vision of a force capable of accomplishing more through innovation. The USAF Posture Statement of 2014 states "The Air Force and our Airmen are committed to being good stewards of every taxpayer dollar. One way we are doing this is by making sound and innovative choices to maximize combat capability within available resources (James, 2014)." Therefore, it is through innovative choices that the USAF will succeed despite financial cuts.

But Airmen are not left to their own devices to assure this success, their senior leaders are also looking for ways to aide their force in this effort. In 2014, Secretary of the Air Force, Deborah Lee James, stated, "We owe it to all of you to have the right level of training, the right equipment, the right supplies, and support to successfully do what we ask you to do. I will work hard to ensure that the best Air Force in the world is the most capable at the lowest possible cost (Air Force Report, 2014)." It is therefore incumbent upon USAF leadership to provide appropriate levels of training, equipment, supplies, and support to maximize combat power at the least cost. But Airmen have

always received these assets, in one way or another. Therefore, Airmen must find more efficient ways to leverage these assets in order to maximize their capability to deliver combat power, at the lowest possible cost to the tax payer. AMC contends, “More than simply being effective, we must redouble our efforts to become more efficient. We must look at leveraging proven technologies and derivative alternates, consider new game-changing technologies, and take action to mitigate operating costs, particularly the potential impact of increasing fuel costs (HQ AMC, 2013).” By understanding the savings associated with reducing the training and operational AR requirements in the C-17A community, MAF leadership could mitigate operating costs, particularly those based on fuel consumption.

Aerial Delivery Operations

Ideally, airlift planners should consider airland delivery as the primary means for most air movements. Airland operations typically fall into one of four types of operations, *Hub and Spoke, Direct Delivery, Stage Operations,* and *Air Bridge Operations.*

During inter-theater hub and spoke operations, personnel and equipment are offloaded at a main operating base in theater. Intratheater operations perform the same operation but allow for personnel and equipment to be offloaded at staging locations prior to being delivered to their final destination in theater. Hub and spoke operations allow planners to maximize the capabilities of each aircraft type as well as providing a safe location for transloading operations by avoiding flights into high-threat or contaminated locations (JP3-17, 2013).

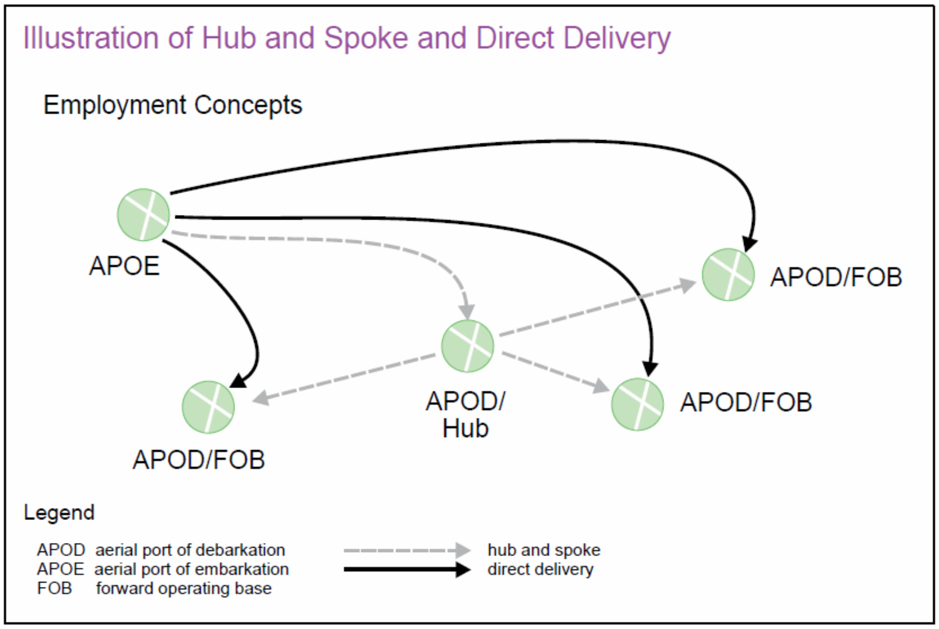


Figure 1: Hub and Spoke and Direct Delivery (JP3-17, 2013)

Direct delivery operations are comprised of moving personnel and equipment from aerial ports of embarkation (APOEs) to main operating bases (MOBs) in theater. By bypassing intermediary operating bases and the transshipment of payloads typically associated with hub and spoke operations, direct delivery typically shortens in-transit time and reduces congestion at main operating bases (JP3-17, 2013).

Stage operations assist in alleviating the troubles associated with aircraft turn times, aircrew sleep cycles, and transloading of cargo on aircraft. Rather, aircraft and cargo are simply flown from an aerial port of debarkation (APOD) to an APOE, a crew change occurs, and the aircraft and cargo continue to the final destination. Limitations to stage operations (also known as lily pad operations) include larger pools of idle crew members and support personnel, increased requirement for infrastructure, and heavier burden on the Global Air Mobility Support System (GAMSS).

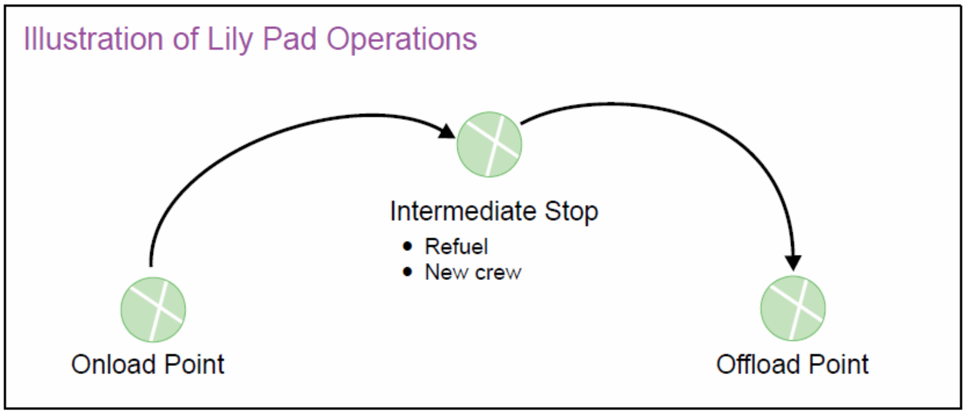


Figure 2: Lily Pad Operations (JP3-17, 2013)

Air bridge operations refer to flights between CONUS and OCONUS terminals where the receiver aircraft's range is augmented by an in-flight refueling on designated AR tracks (JP3-17, 2013). These types of operations require timely coordination between tanker and receiver units, extensive planning by both tanker and receiver crews, and close coordination with the coordinating authority (most often the Tanker and Airlift Command and Control center).

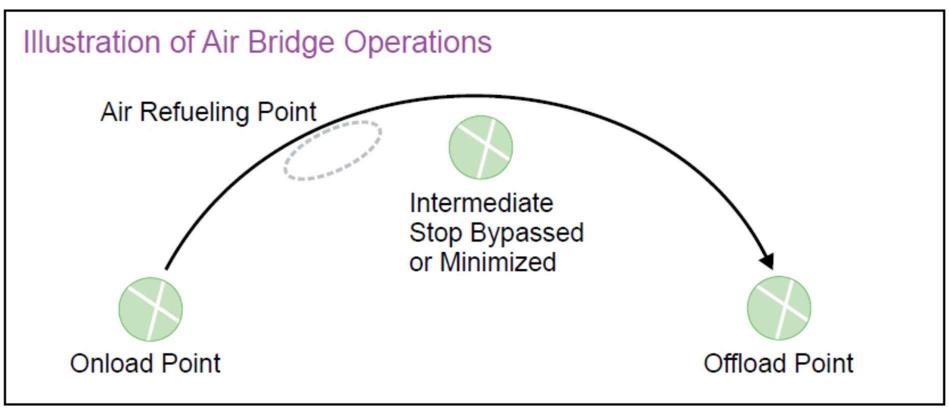


Figure 3: Air Bridge Operations (JP3-17, 2013)

Determining which aerial delivery method should be used depends on the operation. While airlift planners maintain the ability to plan for one of four types of

aerial delivery operations, tanker planners must focus on a separate series of operations of their own to plan.

Air Refueling Support to Aerial Deliver Operations

Tankers perform five basic AR missions including *Global Strike Support, Air Bridge Support, Aircraft Deployment Support, Theater Support to Combat Air Forces, and Special Operations Support* (JP3-17, 2013). Tankers allow military aircraft to fly nonstop from the CONUS to any location around the globe and return. The benefits of AR are three fold. First, tankers eliminate requirements for landing rights in foreign countries. Second, they reduce the need for intermediate basing to refuel and maintain aircraft. Third, they maximize aircraft payloads, either airlifters or combat aircraft, without sacrificing range (Hazdra, 2001).

Air refueling operations do have a supporting role in airlift operations, namely in *Air Bridge Support*. But if air refueling operations support airlift operations, the question then becomes, how often do airlift planners utilize the air bridge mission set? An historical analysis shows the following percentage of C-17 sorties supported by AR from 2001-2014.

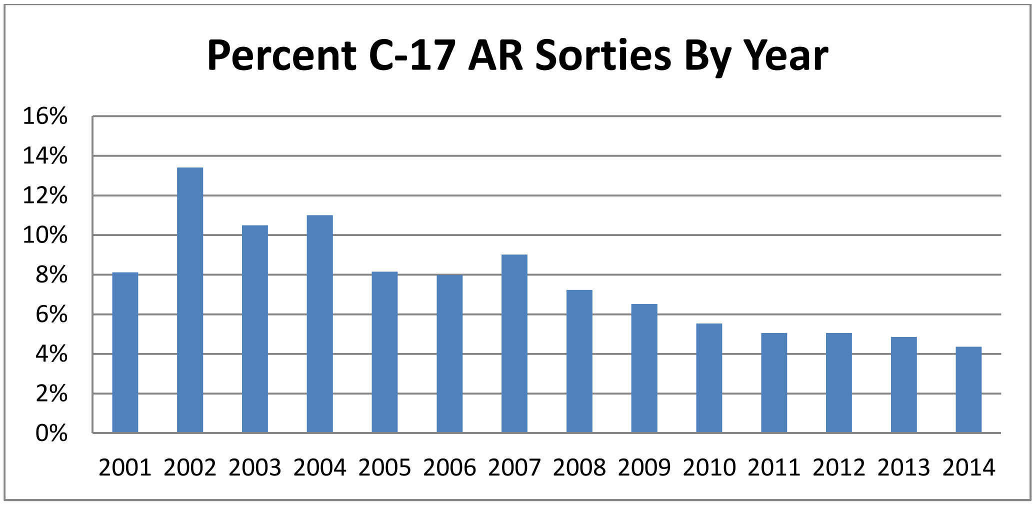


Figure 4: Percentage of C-17 AR Sorties by Year (Author, 2015)

As illustrated in Figure 4, C-17A missions received AR support during a little over 8% of its missions in 2001. However, due to support requirements during the initial operations that supported OPERATION ENDURING FREEDOM, the demand for AR support for C-17A missions increased to almost 14%. But as the years progressed, the demand for AR support decreased to almost half of its "pre-conflict" level, just over 4%.

There are many reasons for a decrease in the demand for AR support by C-17A operations during this timeframe. One reason for this decline could include the costs of the operation. "At current oil prices, it takes more than $30 worth of fuel to deliver one gallon of jet fuel to a plane in flight (Hoy, 2008)." That means in order for a C-17A to receive an offload of 100,000 pounds (14,285 gallons) of JP-8 fuel, it costs the taxpayer $428,571.

Another reason for the decrease in AR support to the C-17A is the introduction of C-17A Extended Range (ER) fuel tanks. Time Compliant Technical Order (TCTO) 1C-17A-1616 is the alpha-numeric designator for C-17A aircraft outfitted with ER fuel

tanks. This TCTO began in Fiscal Year 2001 (FY01) and is scheduled to conclude by the end of FY17 (Fellows, 2015). As outlined in Figure 5, the initial implementation of this TCTO created ten C-17As with ER fuel tanks (13% of the total fleet in 2001). However, by 2014, AMC had retrofit 171 C-17A aircraft (77% of the total fleet) with ER fuel tanks.

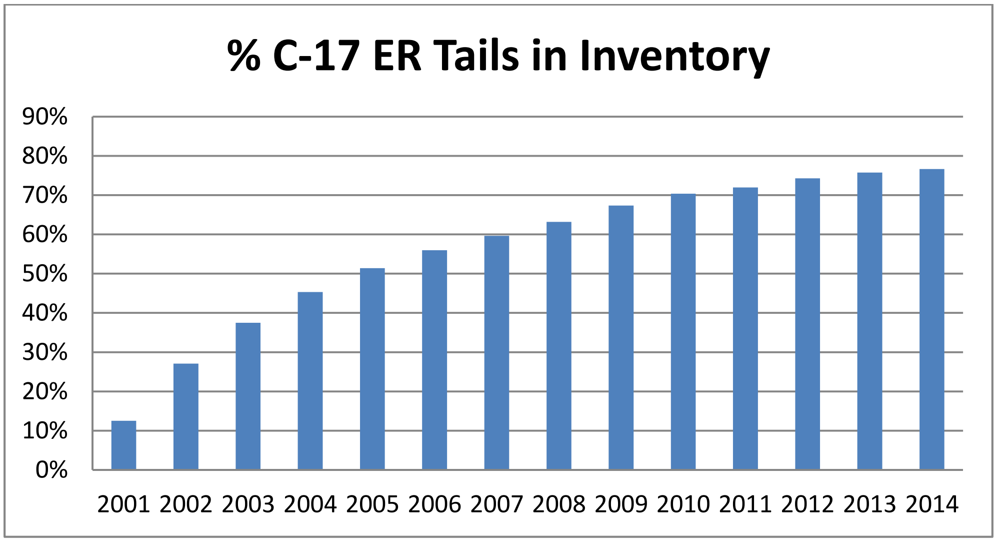


Figure 5: Percentage of C-17 ER Tails in Inventory by Year (Author, 2015)

ER fuel tanks add an additional 67,000 pounds of fuel capacity to the C-17A (T.O. 1C-17-1, 2008). This new fuel capacity increased the range of the aircraft. For example, ER fuel tanks increase the range of the C-17A to be able to carry a payload of 50,000 pounds up to a 6,035 nautical miles (NMs) versus 4,595 NMs without the ER fuel tanks (Appendix A). This range extension is almost the same distance travelled from Charleston, South Carolina to Colorado Springs, Colorado.

Air Force Single Flying Hour Model

"The Air Force Flying Hour Program is a requirements-based, peacetime program consisting of the flying hours necessary to train aircrews to safely operate aircraft while

sustaining them in numbers sufficient to execute the core tasked mission. The Air Force Single Flying Hour Model (AFSFHM) provides the methodology and processes that MAJCOMs will use to build flying hour programs. The model determines the number of flying hours needed to attain and maintain combat readiness for all aircrew. It must be defendable and auditable. To that end, it must be standard across the Total Air Force, connected to readiness indicators, based on the train-to-task concept, easily understood, and most importantly, based on the requirements to train and experience aircrew to perform required Air Force Missions (AFI 11-102, 2011)."

As shown in Figure 6, the Air Force Single Flying Hour Model (AFSFHM) is comprised of five components: *Force Structure, Aircrew Data, Requirements, Calculation*, and *Summary* (AFI 11-102, 2011). The last component is the summary of annual flying hours required to maintain the peacetime combat readiness for each MDS.

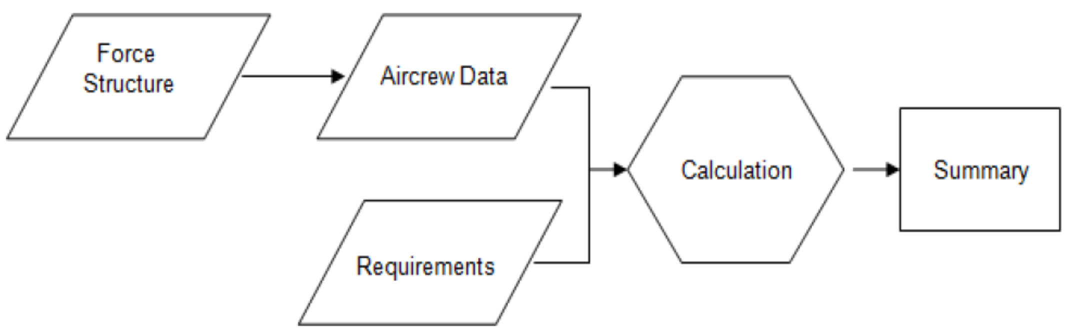


Figure 6: The Air Force Single Flying Hour Model (AF/A3O-AT, 2011, p. 4)

Force Structure is the input site for Primary Aircraft Inventory (PAI) and crew ratio, and determines the number of required pilots. For pilot production, no input is required because its force structure is a function of the student load (AF/A3O-AT, 2001). The current

number of C-17A pilots graduating from Joint Specialized Undergraduate Pilot Training (JSUPT) is 128 pilots (Cooper, 2015).

Aircrew Data provides the types and number of aircrew that require training. It includes calculations for that result in the number of aircrew members by specialty (e.g. pilots, loadmasters, etc.) that require flight training. The crew position that drives the greatest number of flying hours is the total requirement (AFI 11-102, 2001). In the case of the C-17A, copilots require the most hours due to necessary "experiencing" or "aging".

Not annotated in AFSFHM above is how planners' flying hour computations include this "experiencing" calculation. Copilots must accumulate hours permitting them to upgrade at a minimal rate to support planned absorption and crew qualification requirements to maintain a unit's capability to fulfill its assigned missions (AFI 11-102, 2001). This calculation ensures that flying hour programs allow time for inexperienced pilots to "age" at a prescribed rate in a standardized process for all aircraft.

The *Requirements* component includes "those events associated with Undergraduate Pilot Training (UPT), initial and mission qualification training, continuation training, upgrade, requalification, and special capability training events/sorties that aircrew must accomplish during the training cycle" (AFI 11-102, 2011). Continuation training (CT) is a sizeable entry into the requirements of the AFSFHM, and any changes made to the CT program could have serious influence on the calculation of flying hours assigned.

The *Calculation* element of the AFSFHM does just that, it calculates the hours required to accomplish CT for all aircrew in an organization. For operational flying units, Required Hours = Number of aircrews by category x Requirements x Duration (AFI 11-102, 2001). Within this area the individual formulas are listed that calculate the hours necessary

to meet each training requirement (AFI 11-102, 2001). Air refueling continuation training is one example of an operational training requirement that meets this "individual training" requirements formula.

The flying hour program is important because it represents a command's level of combat readiness. Air Force Policy Directive (AFPD) 11-1 states, "The Air Force flying hour program is a closely monitored program that equates flying hours to combat capability. To meet these expectations, the Air Force must explicitly program flying hours that fully support required capability and then execute the resources associated with the flying hours" (AFPD 11-1, 2004). AFPD 11-1 further directs the Air Force to:

- Plan the flying hour program based on peacetime, home station training requirements
- Execute its approved flying hour program to the maximum extent possible
- Allocate resources to support its approved flying hour program

With an understanding of the governance concerning the AFSFHM, the reader can better comprehend the AMC and C-17A Flying Hour Program.

The AMC Flying Hour Program

The AMC Flying Hour Program (FHP) is the method by which AMC determines the hours it requires to maintain a mission ready force in accordance with AFI 11-201. This program not only determines the hours required for aircrew members to accomplish their CT but also the hours it takes to properly age junior pilots and loadmasters.

Appendix B illustrates "The System" by which an AMC pilot upgrades from a UPT/SUPT graduate through "Experienced Aviator". The C-17A process begins with the pilot graduating UPT and entering into training at the Flight Training Unit (FTU). From

there, the pilot fills a position in one of the “absorbable cockpits”. After some time gaining experience in the aircraft at their “Ops Unit”, the pilot returns to upgrade to Aircraft Commander and then returns to their “Ops Unit” to continue gaining experience. After a predetermined amount of experience and flight time has been gained, the pilot returns to the FTU to upgrade to Instructor. They return to their Ops Unit again to spend the rest of their time flying as an Instructor. Instructor is the highest qualification any pilot can receive in the aircraft. Pilots with enough experience will be certified as Evaluator Pilots (EP) by their Squadron Commander.

Within the “Ops Unit” portion of “The System”, AMC determines the appropriate balance of inexperienced pilots versus experienced pilots within a given unit, illustrated in Appendix C. AMC attempts to maintain an even balance of 43% inexperienced seats and 57% experienced seats. 50% of the 57% experienced seats are made up of qualified aircraft commanders (i.e. AC, IP, and EP). The 7% of the 57% experienced seats are reserved for those pilots conducting “upgrades” at any given time (i.e. PCO, IP School, Airdrop Upgrade, etc.). But it is within the 43% of inexperienced pilots that the FHP has focuses most of its attention.

As stated above, AFI 11-102 requires copilots to accumulate enough hours to permit them to upgrade at a minimum rate to support planned absorption and crew qualification requirements. This “mobility aging rate” is defined by the following equation.

$$Aging\ Rate = \frac{MAF\ UPT\ (AF)\ x\ Experience\ Definition\ (MDS\ Vol\ 1s)}{Force\ (MAF\ API\ 1s)\ x\ \%\ Inexperienced\ x\ 12}$$

Equation 1: Aging Rate (Widincamp, 2014)

AFI 11-102 defines "API 1" pilots as line pilots. The number of API-1 aircrew members is derived normally from crew ratio and Primary Aircraft Inventory (PAI) in the force structure component (AFI 11-102, 2001). The 62 Operations Group Instruction (OGI) to AFI 11-2C-17 Volume 1 discusses the prerequisites for copilots to upgrade to First Pilot through the locally developed "First Pilot Course". The 62 Operation Group's First Pilot Course is designed to be the culminating event leading to FPQ (First Pilot Qualified) certification for copilots. It is a concentrated general knowledge review and evaluation designed for copilots with 400 to 700 hours (62 OGI 11-2C-17v1, 2013). In an effort to standardize the computation for all C-17A units, AMC uses an average number of hours gained by pilots attending PCO. AMC defines the Aging Rate for the C-17A community as follows,

$$Aging\ Rate = \frac{128\ x\ 623.6}{620\ x\ .43\ x\ 12}$$

$$\underline{Aging\ Rate = \ 25.0\ hours\ per\ month}$$

AMC FHPs are determined by the Flying Hour Model above which calculates the total hours required each year based on authorized force structure (PAA and aircrews) and required hours per month for experiencing AMC's inexperienced pilots. The first part of the monthly FHP program is comprised of hours earned to meet training table events and are calculated and funded using Operations and Maintenance (O&M) funds. Aircrew must use these hours to complete continuation training events to meet combat

capabilities. Unfortunately, funding for events driven training does not fulfill the number of hours required to age inexperienced pilots in AMC. Therefore, the second part of the monthly FHP uses Transportation Working Capital Fund (TWCF) funds to fill this gap. Appendix D illustrates this concept.

C-17 Air Refueling Training Requirements

The overall objective of the aircrew training program is to develop and maintain a high state of mission readiness for the immediate and effective employment in exercises, peacekeeping operations, contingencies, and war in any environment. Mission readiness and effective employment are achieved through the development and mastery of core competencies…these include the ability to conduct air refueling…(11-2C-17v1, 2012). Each MAJCOM provides flying hours to each wing as training, test, and ferry hours or O&M hours. The hours are designed to provide all crew positions with sufficient hours to accomplish all continuation flying training (11-2C-17v1, 2012). That said, all required training events are broken down by Flight Level, from Flight Level A through Flight Level C. Flight Level A is "Highly Experienced", Flight Level B is "Experienced", and Flight Level C is "Mission Ready" (11-2C-17v1, 2012). Appendix E provides the Air Refueling training requirements by Flight Level in the C-17A community. Based on this information, Flight Level A pilots require six AR events annually, Flight Level B pilots require eight AR events annually, and Flight Level C pilots require twelve AR events annually.

Flying Hour Program Funding

As discussed earlier, the C-17A flying hour program is made up of two types of funding, the Transportation Working Capital Fund (TWCF) and Operations and Maintenance (O&M) funds. All aircraft within the USAF receive O&M funds to pay for aircrew members to accomplish the events that make them mission capable. On the other hand, U.S. Transportation Command (USTRANSCOM) uses airlift assets like the C-17A to transport different users around the globe. That transportation comes at a cost. Much like an airline, USTRANSCOM charges a fee depending on the type of movement required by the user. That payment is made to USTRANSCOM and distributed to its component services (Air Mobility Command, Surface Deployment and Distribution Center, and Military Sealift Command) in the form of TWCF funds. Unfortunately, aircraft like the KC-135R do not maintain a high frequency of TWCF funded missions throughout the year. Therefore, this community funds the overwhelming majority of its operational missions and training flights through O&M funds.

Air Refueling Support Priorities

In order to receive tanker support to an operational mission, exercise, or training sortie, receiver units must coordinate well in advance with tanker units. No later than 90 calendar days before the beginning of each fiscal quarter, all receiver agencies (units, intermediate headquarters, MAJCOMs, and FOAs) must consolidate specific air refueling support requirements for the next fiscal quarter as either a Priority 1, Priority 2, Priority 3, or Priority 4 (AFI 11-221, 1995). The Priorities are set depending on the type of mission the tankers are scheduled to support. Priority 1A missions include Presidential-

directed missions, wartime or contingency combat support designated by the Joint Chiefs of Staff (JCS), and special operations support and other programs approved by the President for top national priority. Priority 1B missions include deployments to conduct contingency operations and special missions directed by the Secretary of Defense or missions in support of counterdrug operations. Priority 2A missions include nonscheduled JCS-directed operational deployments, JCS-directed exercise missions which require air refueling, and extended over water deployments (aircraft range will not allow a fuel stop en route). Priority 2B missions include Foreign Military Sales (FMS) support, aircraft test operations. Priority 2C missions involve JCS exercise missions which require air refueling to meet MAJCOM, NAF, or wing objectives, employment missions in support of MAJCOM-directed exercises or pre-deployment qualification training. 3A missions contain NAF-directed exercises and intratheater deployments and re-deployments. 3B missions span requalification training and upgrade training when air refueling training is accomplished during the missions. 4A missions include missions launched to satisfy US Air Force, Navy, and other DoD agency training requirements. Finally Priority 5 missions include unit to unit scheduled non-allocated air refueling (AFI 11-221, 1995).

Summary

The Department of Defense currently finds itself in a fiscally constrained environment that cannot support the extensive energy bill that previous budgets have afforded. USAF leadership stands ready to provide the means to support its Airmen in

the successful pursuit of their mission but it will require innovative thought to efficiently leverage the capability of every asset at their disposal.

Air refueling is a force multiplying capability that increases strategic airlift's capability to deliver men and equipment from virtually any APOE to any APOD, but at a cost. Studies have shown reasons why conducting air refueling operations to increase throughput is not cost effective. Moreover, technological advances in aircraft, like Extended Range fuel tanks, have further explained the reduced requirements for air refueling in C-17A operations.

The AFSFHM provides a baseline for how the USAF determines the funding it requires to remain combat ready. The AMC Flying Hour Program not only attempts to train its aircrew members in their primary duties but also looks for funding to properly age their inexperienced pilots to backfill those pilots leaving the community. Communities like the C-17A have reaped the benefits of TWCF funding to cover the aging expenses inherent in the AMC model. Unfortunately, aircraft like the KC-135R do not share the same benefit as their funding comes from O&M funds.

This chapter briefly discussed the air refueling training requirements placed on C-17A pilots at all levels. Reducing the number of pilots that require air refueling training will not reduce the number of hours required to age the C-17A crew force. While this reduction in training requirements will cut the amount of O&M funds spent for training, those hours will still need to be flown to age inexperienced pilots. On the other hand, by reducing C-17A air refueling training requirements, KC-135R training requirements will decrease as well, thus driving down its O&M funding requirements. The following chapters will analyze this concept and make recommendations for future operations.

III. Methodology

Chapter Overview

The C-17A community currently requires that all of its aircraft commanders be qualified in aerial refueling. However, at the end of every semiannual period many of them go noncurrent due to an inability to accomplish training for one reason or another. In an effort to understand the costs associated with this dynamic, and attempt to find a way to better manage the crew force and save money, the author determined the average lifecycle costs of putting a pilot through PCO. Next, the author reviewed what percentage of the flying hour program both the C-17A and KC-135R fleets completed over a ten year period. Finally, the author examined how often the C-17A and KC-135R refuel against one another for training. By identifying where the C-17A can reduce its training requirements and save both the C-17A and KC-135R fleet flight hours, the author hopes to find savings for the USAF and DoD.

Pilot Checkout

PCO is the formal training course for all C-17 aircraft commanders. According to the PCO syllabus, the course should take a total of seventeen training days; consist of two simulator sorties, six aircraft sorties, and nearly eight hours of academic instruction via CBTs. Moreover, the total number of dedicated training hours for this course is 98.25 hours (PCO Syllabus, 2013). Over the past six years, the average number of students that attend PCO, annually, is 112 (Delucia, 2015). The costs associated with this TDY include simulator costs, flight hour costs (fuel costs for simplification), lodging costs, and per diem costs. Additional costs that were not considered for this research included

rental vehicle costs (not everyone drives their own vehicle to PCO),mileage costs (for students who drive their own vehicles), rental car gas costs, or airline ticket costs.

After graduating from PCO, pilots must maintain their currency in accordance with AFI11-2C-17 Volume 1. New PCO graduates return to their Operational Units as Flight Level C pilots. Therefore, they are required to accomplish six air refueling events every semi-annual period. Of those six AR events, Flight Level C pilots can credit three events in the simulator. For the sake of this research, the author assumed that each of these pilots will accomplish three AR events in the simulator and three AR events in the aircraft.

C-17A Flight Hour Program

The next data set that the author investigated was the C-17A flying hour program. The author wanted to know what percentage of its flying hour program that the C-17A community actually flew over a given period of time. The data set was provided by AMC/A9 and summarized in Figure 7. It was a spreadsheet that contained the programmed versus actual hours flown by all mobility aircraft from FY98 to FY15. For the sake of this research, the author narrowed the data set to cover the years from FY01 to FY14.

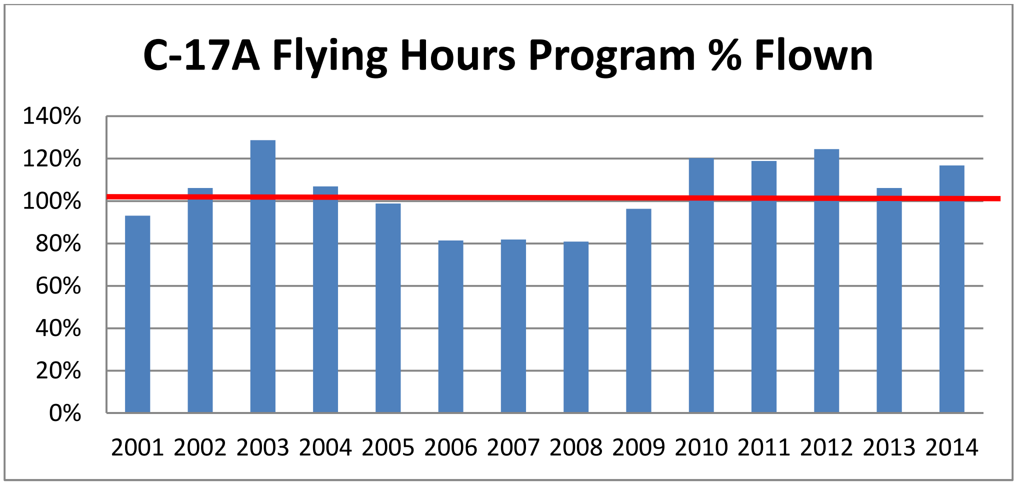


Figure 7: Percentage of C-17 Flying Hours Program Flown (Author, 2015)

The red line was added to Figure 7 to highlight where 100% or more of the projected flying hour program was executed. By looking at the flying hour program in this manner, it was easy to determine where the C-17A community failed to fly all of its allocated hours and where it overflew. In the years it was under flown, the aging requirements were not met. In the years that the flying hour program was overflown, the aging requirements for inexperienced pilots were met and excess hours were flown. These years represent areas where reducing training requirements could translate into hours and money saved for AMC.

KC-135R Flying Hour Program

In addition to the C-17A flying hour program AMC/A9 also provided data for the KC-135R flying hour program covering the same years. For consistency, the author focused on the same timeframe from FY01 to FY14. The results of the analysis are provided in Figure 8.

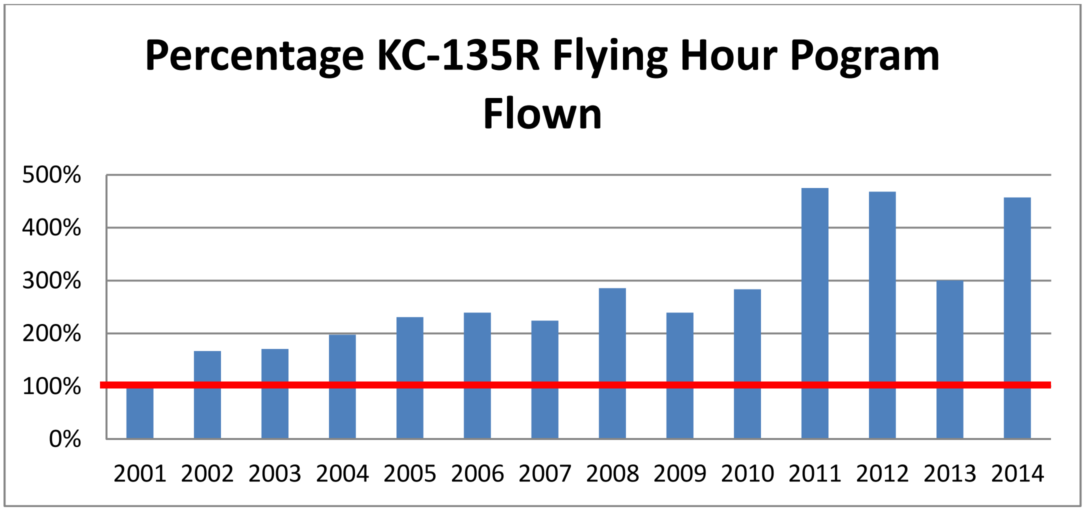


Figure 8: Percentage of C-17 Flying Hours Program Flown (Author, 2015)

Again, like the C-17A data set, the author added a red line to highlight where the KC-135R flying hour program had flown 100% of its programmed flying hours. Surprisingly, not only did the KC-135R community manage to fly 100% of its flying hours program every year, some years it flew greater than 450% of its programed hours. As outlined in Chapter 2 of this research, the tanker fleet accomplishes a myriad of mission sets. As such, it is understandable that the tanker flying hour program would exceed its projections from year to year. However, by reducing C-17A air refueling training requirements, would that reduce the number of hours the KC-135R community overflew its flying hours program? And, if so, by how many hours would the program be reduced, and how much money would that save the USAF?

Comparing C-17A and KC-135R Training

Multiple databases were referenced in order to compare the air refueling operations conducted between the KC-135R community and the C-17A community. The Priority 1, 2, and 3 air refueling data was pulled from "thumped" data. Thumped data is

data that comes from the "Tankolator", a locally developed program used at the 618th Air Operations Center at Scott AFB, IL. The Tankolator pulls data from GDSS II and the AMC Fuel Tracker. The data were then scrubbed to ensure that all actual information that is available is attributed correctly to the mission. The Priority 4 and Priority 5 air refueling missions were pulled directly from the AMC Fuel Tracker. These data were put into AMC Fuel Tracker by the crew/Aviation Resource Management Services (ARMS) personnel. For the sake of this research, all complete data were assumed to be accurate. Unfortunately, the data analyzed did not encompass the previously studied timeframe of FY01 to FY14. This was due to the fact that AMC Fuel Tracker did not exist until FY11. Because of this, only FY11 to FY14 data was available. However, this provided a database of 11,781 air refueling missions for analysis. Of those missions, 358 missions that had a C-17A mission match had incomplete data and were discarded.

After all of the original data were obtained, the author requested analysts at the 618 Air Operations Center (AOC) to break out the mission according to the following criteria. First, the missions needed to be separated based on mission priority (i.e. 1, 2, 3, 4, or 5). Second, the data had to delineate between AMC assets and assets from other MAJCOMS. The analysts noticed that the information included missions where KC-135R aircraft from multiple MAJCOMS (i.e. PACAF, AMC, and USAFE) had air refueled with C-17As from AMC and PACAF. Therefore, the author requested that the analysts further separate the data into KC-135R aircraft from each MAJCOM that air refueled with C-17A aircraft from AMC. This would allow for the author to analyze the results of decreasing C-17A air refueling training requirements across the spectrum of KC-135R community. The results of this analysis are found in Chapter 4.

Assumptions

The findings, discussed in the next chapter maintain the following list of assumptions:

1. The number of hours required to accomplish an air refueling event are constant.
2. Each event requires a 10% re-fly rate.
3. The cost per flying hour for both the C-17A and KC-135R is constant.
4. All data input into GDSS II and AMC Fuel Tracker is correct.

Summary

This methodology analyzed the flying hour programs of both the KC-135R and C-17A communities. It assessed how many hours were flown above and below the projected flying hour program by year. From those findings, further analysis assessed how many of those hours were attributed to C-17A air refueling training. Using the simplifying assumptions above, the next chapter will highlight the potential savings associated with reducing C-17A air refueling requirements, not only operationally but also in the training environment.

IV. Analysis and Results

Chapter Overview

This chapter explores the costs associated with C-17A air refueling training operations as they take place today. It will analyze two different costs related to maintaining an air refueling capability in the C-17A community, training the force (i.e. PCO) and maintaining the force (i.e. Continuation Training). The intent of this chapter is to identify the cost savings that can be found through the manipulation of today's current model. The final chapter of this paper will assess the significance of these findings and make a recommendation for future C-17A air refueling training program requirements.

Pilot Checkout

As discussed earlier in this paper, the C-17A community requires its prospective Aircraft Commanders to conduct preparatory flight and simulator training prior to attending PCO. The intent of this training is to better prepare PCO candidates for the demands of air refueling and assault training. That training consists of a training simulator flight with an Instructor Pilot, a tactical simulator flight with an IP, and a night local flight (Airland PDG, 2014). To assess the costs of these operations, the following assumptions were made:

1. The average number of students who attend PCO annually is 112.
2. Total operating cost per C-17A flight hour is $10,300.
3. Total operating cost per KC-135R flight hour is $5,500.
4. The number of hours required per air refueling training event is 2.5 hours (based on the current C-17A flying hour program model).

5. A refly rate of 20% for PCO preparatory training flights based on the number of additional pilots onboard any particular training line.

6. The hourly cost of operating a C-17A simulator is $850.

The operating cost per aircraft hour flown was simplified by only identifying the cost of fuel multiplied by the pounds per hour that each aircraft burns. The author identified the cost per gallon of JP-8 as $3.26 (DLA, 2015). Next the author identified the pounds per hour fuel burn for both the C-17A and KC-135R. The planned fuel burn for the C-17A and KC-135R are 21,097 and 11,291 pounds per hour, respectively (AFPAM 10-1403, 2011). The author then multiplied the burn rates by a conversion factor of 6.7 (pounds per gallon) to determine how many gallons per hour were burned. Finally, those numbers were multiplied by $3.26 to determine the cost per operating hour. The cost per flight hour for the C-17A and the KC-135R, based on these calculations, is $10,265.11 and $5,493.83, respectively. To simplify the analysis, these costs were rounded to $10,300 and $5,500. Therefore, the annual cost of performing PCO preparatory training is $5,572,000, as outlined in Table 1 below.

Table 1: PCO Preparation Costs (Author, 2015)

	Tactical Simulator	Regular Simulator	Night AR Flight	Tanker Costs
Number Required	1	1	1	1
Refly Rate	1	1	1.2	1
Student Required	112	112	112	112
Hours Required	3	3	2.5	2.5
Cost Per Hour	$850.00	$850.00	$10,300.00	$5,500.00
Sum	$285,600.00	$285,600.00	$3,460,800.00	$1,540,000.00
Total Cost	$5,572,000.00			

Once students depart home station to attend PCO, they begin charging costs to the USAF for that training in the form of per diem, mileage, etc. The number of days a student is TDY is dependent on a number of variables including distance travelled to Altus AFB from home station, whether or not the student progresses through each ride or does not meet the minimum requirements to progress in the PCO program, whether or not an aircraft breaks (C-17A or KC-135R), etc. To simplify this problem, the author polled a group of ten PCO graduates from various bases and determined that the average number of TDY days as 41 days. This correlated to an average per diem cost of $1,542.38. For ease of analysis, this cost was rounded to $1,500.00 per student.

Like per diem, the number of flights it takes a student to successfully complete PCO can vary. Polling the same group of pilots, the average number of sorties required to complete PCO was 7.33. For the sake of this analysis, the author rounded that number down to 7 sorties.

Also dependent on how long a student remains at PCO is the cost of lodging. Lodging costs can fluctuate depending on whether or not the student is lodged on or off base. As before, to simplify this calculation the author took an average of the polled students and found the average lodging costs per student to be $1,866.67. For ease of analysis, this cost was rounded to $1,900.00 per student.

The same simplifying assumptions for PCO preparatory training were used to analyze the costs of PCO annually. Combining all of this information, the author found the total cost of sending 112 students to PCO was $31,642,240. The model used to identify these costs is outlined in Table 2.

Table 2: PCO Costs (Author, 2015)

Pilot Checkout Cost

	Average	Cost/Hour	Number Students	Total Cost
Sims	2	$850.00	112	$571,200.00
C-17 Flight Hours	23.4	$10,300.00	112	$26,994,240.00
Lodging Cost	$1,900.00		112	$212,800.00
Per Diem Cost	$1,500.00		112	$168,000.00
KC-135 Flight Hours	6	$5,500.00	112	$3,696,000.00
			Total PCO Cost	**$31,642,240.00**

Continuation Training

The next major cost associated with requiring all aircraft commanders to be qualified in air refueling is maintaining the force. In order to measure this cost, the author needed to determine the total number of aircraft commanders, at all levels, AMC maintained. According to the current C-17A Model, in FY16, AMC will have 202 ACs. Of those AC's, 53 are airdrop qualified. Because airdrop aircraft commanders require formation air refueling training, they were removed from this analysis. This left 149 Level B aircraft commanders from which to find savings. Additionally, the C-17A Model identified that AMC will have 68 Level C aircraft commanders in FY16. All of these ACs were analyzed for savings in this analysis.

Next, the author identified the frequency that Level B and Level C aircraft commanders required AR training. As outlined in Appendix E, the C-17A community requires its pilots to accomplish AR training with the following frequency. Flight Level B pilots require eight AR events annually and Flight Level C pilots require twelve AR events annually. However, because half of the air refueling events can be logged in the

simulator, only half of the annual requirements are included for cost savings analysis. Due to the fact that IPs will have more opportunities to conduct AR in the jet (because they are instructing), the author assumed the number of events flown in the aircraft for Level B ACs was 6.

Next, the author identified the number of flight hours AMC charged per air refueling training event. Again, according to the C-17A Model, AMC assesses that each pilot required 2.5 hours of flight time to accomplish a single air refueling event. Finally, the author identified the average percentage of Level B aircraft commanders that were not an Evaluator or Instructor pilot. The author analyzed the pilot makeup of the 62d OG and found that 40% of the Level B pilots at JBLM were ACs. Therefore, as a simplifying assumption, the author applied this percentage to the entire C-17A community.

The analysis of the air refueling continuation training began by multiplying the number of Level B aircraft commanders (149) times the number of required events in the aircraft (6) times the number of hours programmed per event (2.5) for a total hours requirement of 2,235 programmed flight hours. By reducing the requirement for aircraft commanders to train in air refueling, this number was multiplied by 0.4 to identify a flying hours cost savings of 894 hours. Next the Level C aircraft commanders (68) were multiplied by the number of training events (6) times the number of programmed flight hours (2.5) for a total hour requirement of 1,020 hours. This combined with the Level B flight hours savings of 894 resulted in a total hour savings of 1,914 hours. Using the current C-17 Model as a foundation, the author multiplied this hour requirement by a re-fly rate of 10% resulting in a total required hours of 2,105.4 hours. Multiplying these hours by the operating costs for both KC-135R and C-17A aircraft used in the PCO cost

analysis resulted in a total cost savings of $33,265,320. The model for this analysis is identified in Appendix F.

Additional Considerations

Another way to look at the potential cost savings is through the analysis of historical air refueling data. As discussed in Chapter 3, the 618th Air Operations Center at Scott AFB, IL provided a breakout of C-17A sorties supported by KC-135R tankers. It was further broken down by mission priority. This analysis is shown in Table 3.

Table 3: KC-135R v. C-17A Hours (618 AOC, 2015)

AMC KC135 Flying Hours Against C17 Receiver Type						
CY	PRIORITY 1	PRIORITY 2	PRIORITY 3	PRIORITY 4	PRIORITY 5	TOTAL
2011	1797.4	66.6	13.5	4128.3	199	6204.8
2012	680.4	57.5	879.1	7300.7	194.1	9111.8
2013	282	32.9	1923.7	6916.3	243.4	9398.3
2014	153.6	71.8	1661.9	6870	52.3	8809.6

USAFE KC135 Flying Hours Against C17 Receiver Type						
CY	PRIORITY 1	PRIORITY 2	PRIORITY 3	PRIORITY 4	PRIORITY 5	TOTAL
2011	125	0	0	0	0	125
2012	187.6	0	8.2	78.1	0	273.9
2013	122.4	0	0	61.8	0	184.2
2014	87	0	0	92.9	0	179.9

PACAF KC135 Flying Hours Against C17 Receiver Type						
CY	PRIORITY 1	PRIORITY 2	PRIORITY 3	PRIORITY 4	PRIORITY 5	TOTAL
2011	5.8	11.8	110	16.9	0	144.5
2012	12.5	0	152.6	16.8	0	181.9
2013	6.7	0	212.7	5.5	0	224.9
2014	5.5	27.9	241.3	12.6	0	287.3

Unfortunately, that data only covers the timeframe from FY11 until FY14 due to the fact that the AMC Fuel Tracker did not exist prior to FY11. Priority 3 and Priority 4

operations include the preponderance of air refueling training sorties. Therefore, by adding Priority 3 and 4 hours, annually, and by category, the author determined the total number of C-17A air refueling training hours conducted by year. Next the total number of hours was multiplied by the cost per operating hour for both the C-17A and KC-135R to determine the total cost of these operations. Finally, that summation was multiplied by 40% (percentage of aircraft commanders in AMC) to evaluate cost savings. The results by year are as follows:

Table 4: C-17A AR Savings by Year (Author, 2015)

	2011 Savings	2012 Savings	2013 Savings	2014 Savings
Total Annual Savings	$67,445,460	$133,280,900	$144,096,000	$140,283,460
No AC Savings	$26,978,184	$53,312,360	$57,638,400	$56,113,384
Average Annual Savings	$48,510,600			

Using this model, Table 4 identified an average savings of $48,510,600 over this four year period. Surprisingly, this analysis identified the cost of maintaining the force (i.e. continuation training) as being $15 million more than the analysis in Appendix F. One reason for this disparity is that the analysis in Appendix F does not include AC's qualified in airdrop. Moreover, the analysis in Appendix F assumed that pilots accomplish only those AR training events that are required. However, pilots, especially IPs and EPs, typically accomplish more AR events than required, potentially accounting for the difference between the findings in Table 4 versus those in Appendix F.

Summary

This chapter presented multiple models used to analyze potential cost savings associated with reducing the number of AR qualified pilots in the C-17A community. First, the lifecycle costs of training a C-17A pilot at PCO were explored. The initial training costs associated with preparing a pilot for PCO training were analyzed first. These costs were identified as $5,572,000. Additionally, by analyzing the per diem, lodging, simulator, and operating costs of PCO, the author identified a potential savings of $31,642,240. This chapter also assessed the costs of maintaining today's C-17A crew force in air refueling. This analysis identified $33,265,320 in total savings. Combining these three costs resulted in a total annual savings of $70,479,560.

This chapter also utilized an historical model to calculate the savings that AMC could gain from reducing its AR training requirements. This analysis assessed the total hours that C-17A and KC-135R aircraft conducted AR operations with one another during FY11 through FY14. The result was an average annual savings of $48,510,600. The impact that these savings could have on the community will be discussed in the next chapter.

V. Conclusions and Recommendations

Chapter Overview

In today's fiscally constrained environment, the United States Air Force must look for and leverage cost savings initiatives that will improve the efficiency of the force. The cost savings associated with reducing the required number of C-17A pilots qualified in air refueling are real. This chapter assesses the significance of these findings and makes recommendations for future C-17A air refueling training requirements.

Conclusions of Research

The goal of the Air Force Single Flying Hour Model is to get inexperienced pilots the flying hour experience they need to qualify as an Aircraft Commander. It is not based on the number of hours required to afford pilots the opportunity to gain proficiency in a given capability, like air refueling. From FY01 through FY14, the C-17A community routinely flew nearly 100% of its programed flying hours. Over the same period, the KC-135R community never flew less than 101% of its flying hour program. As a matter of fact, the KC-135R community flew over 450% of its flying hour program from FY11-14. This excessive flying can be attributed primarily to contingency operations overseas but it highlights excess costs that AMC can leverage to save money.

Air refueling for the C-17A community is a capability that is rarely used operationally. In nine years of experience, the author experienced two missions that required operational air refueling. From FY01 through FY14, the percentage of C-17A missions requiring AR decreased from a high of 13% in FY02 to 4% in FY14. This decrease in AR requirements can be attributed to a number of factors including an

increased U.S. military footprint throughout the world, more fuel available in places like Afghanistan, and the number of C-17A aircraft modified with extended range (ER) fuel tanks. From FY01 until FY14, the percentage of the C-17A fleet with ER modifications increased from 13% to 77%. This increased capability is a good reason for the decreased demand in operational air refueling. With this decrease, should AMC require all of its C-17A Aircraft Commanders be qualified in Air Refueling?

By getting rid of the PCO course at Altus, the air force could save $31,642,240. Moreover, removing this requirement would also eliminate the prerequisite PCO training of 112 pilots at a cost of $5,572,000, for a total savings of $37,214,240. Combining these savings with the annual training requirements cost identified by this research provided a total annual savings of $70,479,560. This research also analyzed data from the 618 Air Operations Center at Scott Air Force Base to identify the number of hours that C-17As and KC-135Rs performed air refueling with one another over a four year period. Using the same assumptions made to investigate the costs of training and maintaining an AR capable force; this information revealed an annual cost savings of $48,510,600. Unique to these models was the manner in which the savings were identified.

The cost per flying hour of a C-17A and a KC-135R is a difficult metric to quantify. Flying hour costs are broken down into fixed costs and variable costs. The fixed costs are those costs associated with owning the aircraft while the variable costs represent the costs of flying the aircraft. This analysis utilized a simplified model in order to compare costs shared by each aircraft. Using fuel burn rates found in Air Force Pamphlet 10-1403 and multiplying them by the Defense Logistics Agency cost of JP-8 (per gallon), the author was able to define the cost per hour flown by each aircraft. This

calculation determined the cost per hour to fly the C-17A and the KC-135R was $10,300 and $5,500 (rounded), respectively. Although this calculation identifies the cost per flying hour of a C-17A as $10,300, some sources indicate this cost can be as much as $20,340 (USAF, 2013). If this is the case, this research would provide an increase savings of $25 million a year for every $5,000 in operating costs per C-17A. Therefore, as the operating costs of these aircraft increase, the savings associated with modifying the training requirements for the crew force will also increase.

Significance of Research

The abstract of this Graduate Research Project noted that at the conclusion of this research the Air Force could gain significant savings by reducing the number of pilots it trains in Air Refueling. Although a single C-17A aircraft costs nearly $200 million, saving $70 to $100 million on annual training does not seem significant (Defense, 2015). However, the significance of this research is more than just cost savings; it is the paradigm shift that can take place by looking at air refueling from a new perspective. Modifying C-17A air refueling requirements based on current technologies and historical demand opens up opportunities for significant change within the community.

Recommendations for Action

Air Mobility Command should immediately begin changing the way that it trains its C-17A pilots in Air Refueling. It should reduce its requirement that all Aircraft Commanders be qualified in this mission set to only the Instructor and Evaluator Pilots. The effects of this change will not only prove beneficial financially but it will pay

dividends in the proficiency of the C-17A community. The following recommendations outline this road to change.

First, new Aircraft Commanders will not receive a qualification in Air Refueling. Training all ACs in AR is costly with a small return on investment. Many PCO graduates depart the C-17A community for assignments that have nothing to do with the C-17A. The number of pilots who move from one C-17A assignment to another is approximately two pilots per squadron per cycle (Gray, 2014). Additionally, PCO does not prepare aspiring ACs to perform their part of the global mobility mission. Rather, this course requires these airmen to step out of their routine of flying operational missions to earn a qualification in a mission set they may never use. Instead of creating this break in the upgrade process, PCO should be removed from the upgrade curriculum.

However, these young aircraft commanders will not be exempt from the AR training requirement altogether. Instead, ACs will receive local training at their home station during the AC upgrade process to familiarize them with AR. Once certified as an AC, they will maintain currency in the simulator during their quarterly Phase Training. Once identified as a candidate for Instructor Pilot upgrade, these pilots will then begin training for AR in the aircraft. This approach provides multiple benefits. First, it saves the Air Force $9,415 per hour training these ACs in the simulator versus the aircraft. Second, it streamlines the upgrade process to AC by removing the "break" at PCO allowing these pilots the opportunity to focus solely on global operations. Next, this process provides AMC with a C-17A AC force familiar with AR operations, capable of "spinning up" quickly should COCOM demands require it.

In recent months, the Chief of Staff of the Air Force masked officer accomplishments outside of their primary job responsibility (i.e. Masters Degrees), leaving commanders less information to effectively rate their airmen amongst their peers. An AR qualification could serve as a stepping stone metric for commanders to rate the capabilities of their pilots. Moreover, this qualification could serve as an incentive to those pilots looking to remain in the C-17A community for multiple assignments.

Yet another benefit of manipulating AR training requirements is removing PCO from the upgrade syllabus. This would reduce the manning footprint at Altus Air Force Base by reducing the IP requirement at the FTU. In turn, the IPs that would normally be based there could return to operational units, further increasing the impact that those units could have on “real world” missions. If nothing else, returning Altus IPs to the operational units would increase the AR capability of those units.

The benefits of reducing AR training requirements in the C-17A are intriguing. This reduction saves money, incentivizes upgrading in the C-17A community, and reduces demands on the crew force. Second and third order impacts of this shift in training requirements will require further research.

Recommendations for Future Research

This investigation highlighted many opportunities for the Air Force, AMC, and the C-17A community. However, in order to keep the topic focused narrowly on AR, the research could not expand on the second and third order effects of its recommendation leaving many topics available for future research. First, reducing AR training requirements in the C-17A would reduce training hours for the KC-135R but no

consideration was given to the effect it would have on KC-135R training other than simply reducing training hours. Future research should indicate the impact this research's recommendation would have on pilot and boom proficiency air refueling against a C-17A aircraft.

Additionally, this research recommended moving AR currency to the simulator. This training would serve as "familiarity training" for ACs reducing the "spin up" time should the need arise for a rapid buildup in C-17A air refueling capability. Future research should investigate the impact of moving AR training almost entirely to the simulator. The current C-5 AR training model requires its pilots to receive their annual AR qualification in the simulator, rather than the aircraft. The impacts of this model in the C-17A community could save further training costs for AMC and the Air Force.

As recommended by this research, reducing training requirements could remove the PCO course from Altus altogether. Reducing the pilot requirements at Altus could increase the capabilities of the C-17A crew force at operational bases across the country. Future research should investigate the impact that this policy could have on the structure of the C-17A crew force, UPT outplacement implications, and even pilot retention in the community.

Finally, reducing the Air Refueling capability of the C-17A decreases the aircraft's ability to provide sufficient airlift for the Combatant Commanders. However, the implications of this reduction could be transformational for the community. The questions then become; how much capability are COCOMs willing to give up and at what cost? Future research should investigate the Acceptable Level of Risk (ALR) that

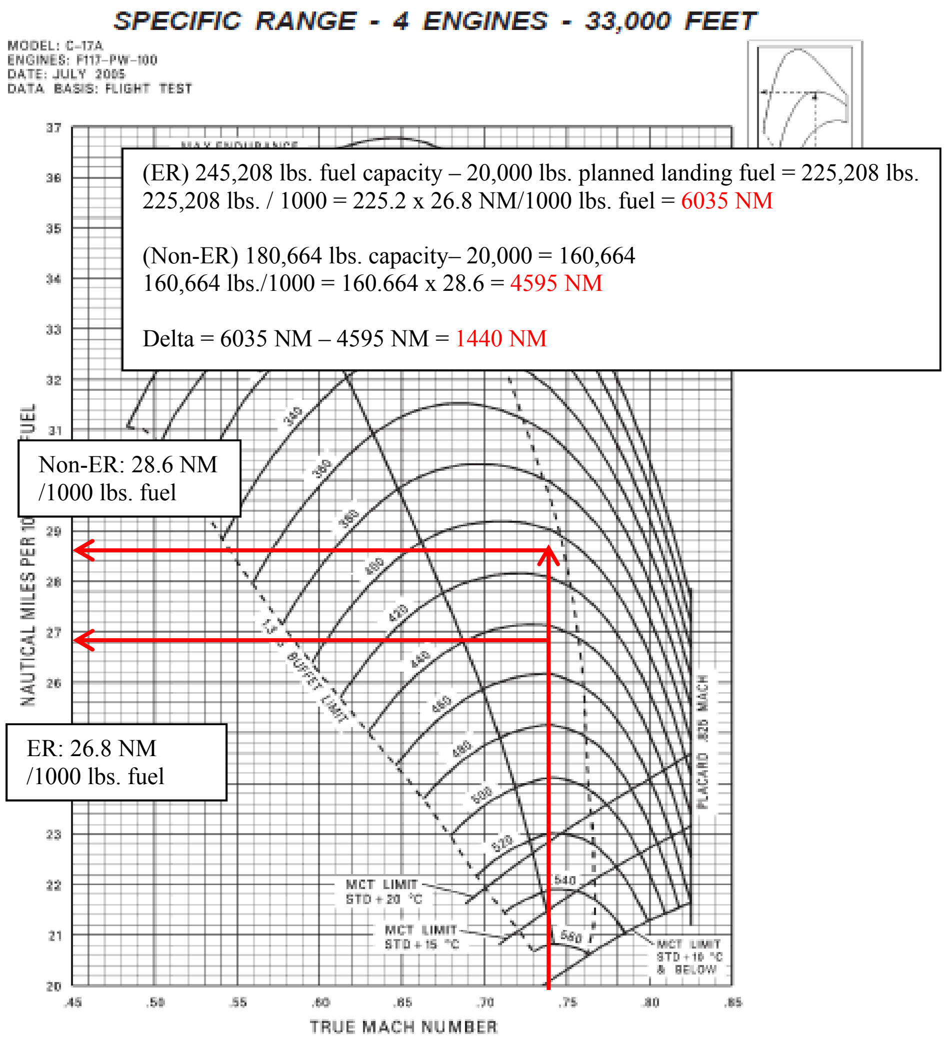
commanders are willing to accept in order to benefit from the changes to C-17A training discussed in this GRP.

Summary

Today's Air Force faces fiscal constraints never before seen in previous generations. Overcoming those constraints will require initiatives that challenge the status quo to find efficiencies to past operations. Examining how C-17A pilots train for Air Refueling operations is one of those initiatives. Reducing this capability in the C-17A community is an intimidating prospect. After all, once a force shows that it can operate without a capability, it becomes difficult to regain it. Air Refueling is a force multiplier but it comes at a cost. Adjusting this training requirement in accordance with this GRP could save Air Mobility Command between $70 and $100 million a year. But more than the cost savings, reducing this capability will change the landscape of the C-17A community. It could help rebalance the crew force, incentivize upgrades, reduce demand on the crew force, and increase pilot proficiency. Tomorrow's Air Force will be smaller, more technologically advanced, and more capable than ever before. By capitalizing on initiatives such as these, today's Air Force will bridge the gap to meet the demands of tomorrow.

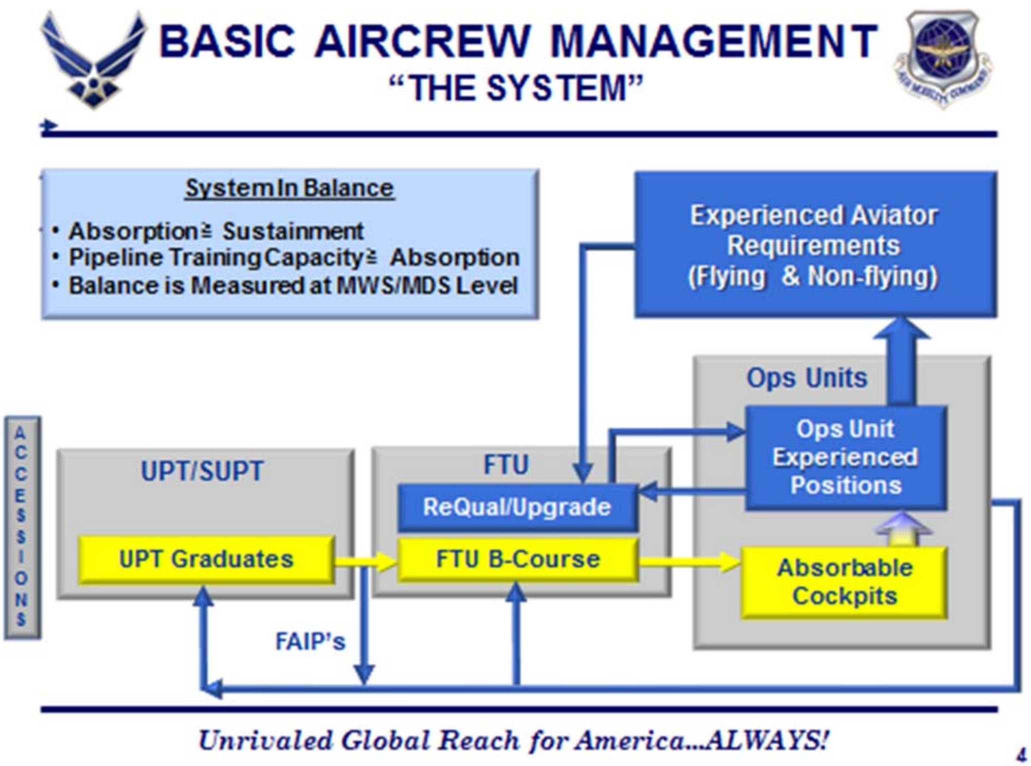
Appendix A: C-17A Specific Range Calculations

Assumptions: 282,500 lbs. basic weight, standard day, optimum cruise altitude 33,000 ft., cargo weight 50,000 lbs., cruise airspeed Mach.74, average gross weight 445,000 lbs. (ER), 412,000 lbs. (non-ER)



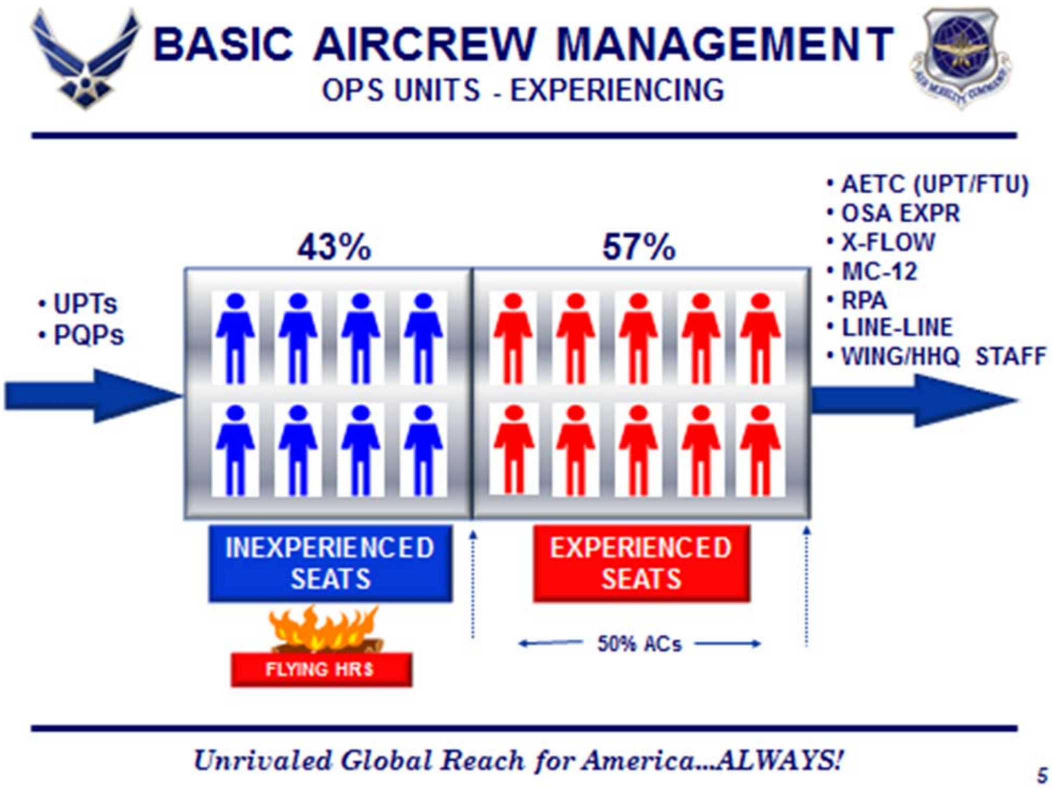
Source**:** Technical Order (TO), 1C-17A-1-1, *Flight Manual, USAF Series C-17A Aircraft*, 15 October 2008, Figure 5-35.

Appendix B: Basic Aircrew Management "The System"



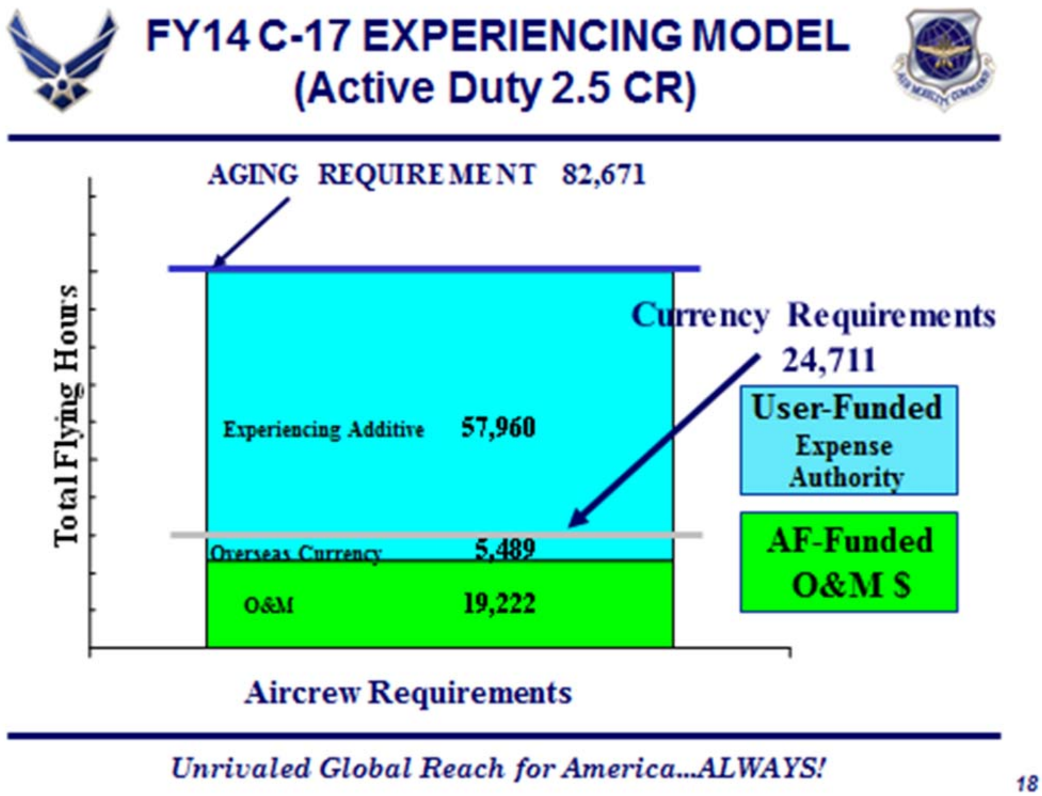
Source: Headquarters Air Mobility Command: AMC Flying Hour Programs, 9 April 2014.

Appendix C: Basic Aircrew Management "Ops Units – Experiencing"



Source: Headquarters Air Mobility Command: AMC Flying Hour Programs, 9 April 2014.

Appendix D: FY 14 C-17 Experiencing Model



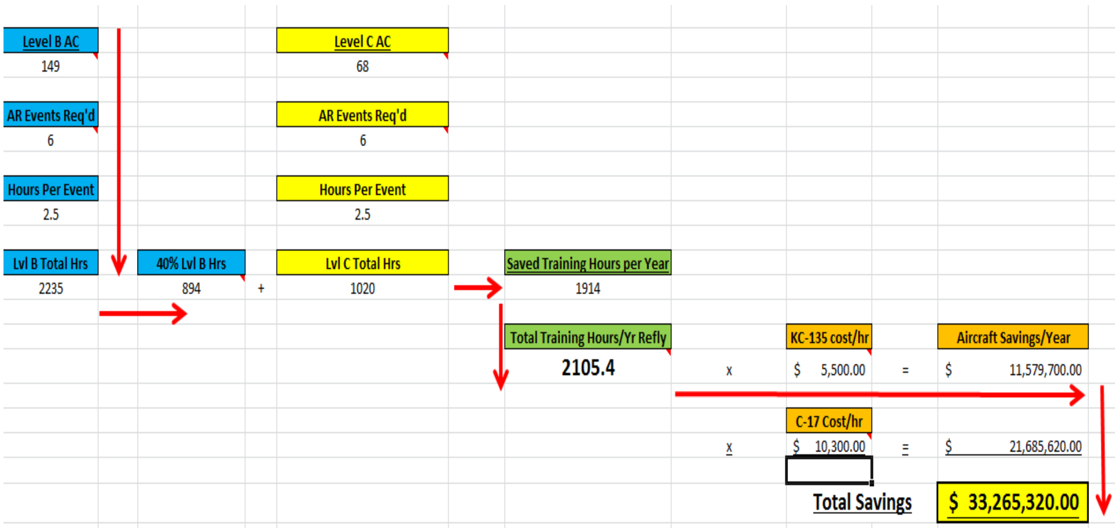
Source: Headquarters Air Mobility Command: AMC Flying Hour Programs, 9 April 2014.

Appendix E: Excerpt from AFI 11-2C-17V1

		Aircraft Commander (FPL+)					Pilot (FPQ)					Creditable in WST			
Code	**Event**	**A**	**B**	**C**	**E**	**CUR**	**A**	**B**	**C**	**E**	**CUR**	**% or Qty**	**Maintain**	**Regain**	**Notes**
AS12	Landing, LZ Nt	1	1	2			1	1	1			100 %	Yes	No	5,6, 10
AS21	Heavy Wt Full Flap	1	2	2			1	2	2			100 %	Yes	Yes	6
AS22	Heavy Wt Full Flap, Night	1	1	1			1	1	1			100 %	Yes	Yes	6
	Air Refueling Events														
R010	Receiver AR	3	4	6		A/B-60d C-45d						A/B-2 C-3	Yes	No	5,8
R020	Receiver AR (Night)	2	2	2		**B/C-Q**						A-100% B/C-50%	Yes	No	5
R050	Rcvr AR, Tanker AP Off	1	2	2		**B/C-Q**							No	No	

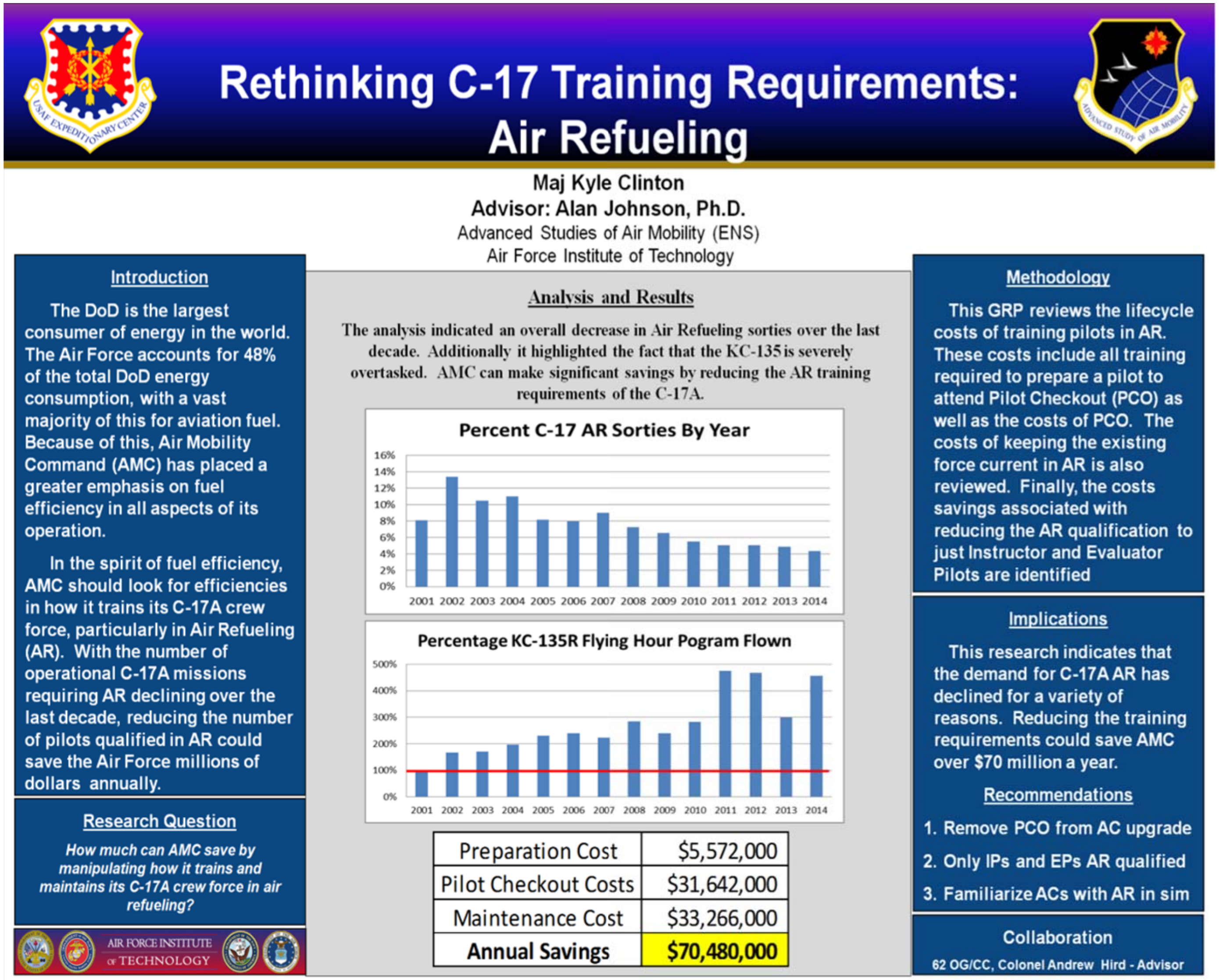
Source: AFI 11-2C-17 Volume 1, *Flying Operations*, 1 June 2012

Appendix F: Cost Savings Model Caluclation



Source: Author, 2015

Appendix G: GRP Storyboard



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